A METHOD AND A DEVICE FOR SUPPLYING AIR TO AN INTERNAL COMBUSTION ENGINE

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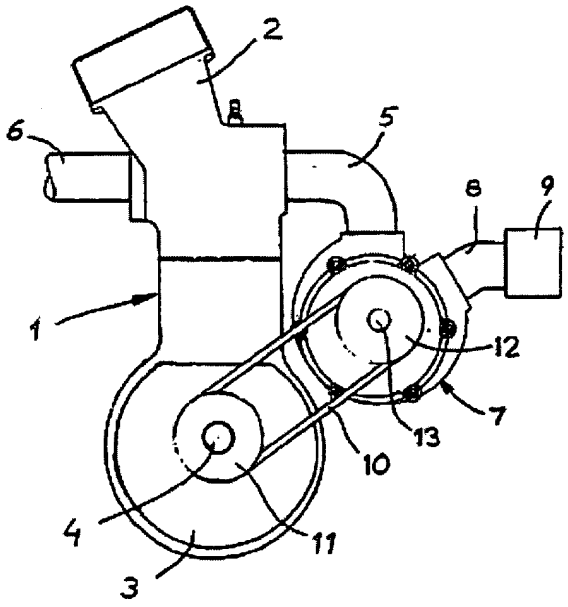
Abstract of **WO9400680**

The invention relates to a process for charging air into the intake system (5) of an internal combustion engine (1) by means of an engine-driven air charging device (7) with regulator means for regulating the flow of air to the engine depending on the current air requirements of the engine. The process is characterized in that for each operating cycle, a specific amount of air is delimited, which is fed through the air charging device (7) and is subjected to a change in its state, so that upon delivery to the intake system (5) it has essentially the same state as the air in the intake system (5). The air flow through the engine (1) is regulated by changing the volume of each amount of air when it is delimited. The invention also relates to an air charging device (7) for carrying out the process, said air charging device (7) being provided with at least one air chamber, which is moved for feeding a specific, delimited amount of air from an inlet duct to a delivery duct, from communication with the inlet duct to communication with the delivery duct, by means of a drive arrangement (10-12), which is driven by the engine (1) in a predetermined relationship to the rotation of the engine crankshaft (4). The regulator means are arranged to regulate the volume of each air chamber when it communicates with the inlet duct.



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(57) Abstract

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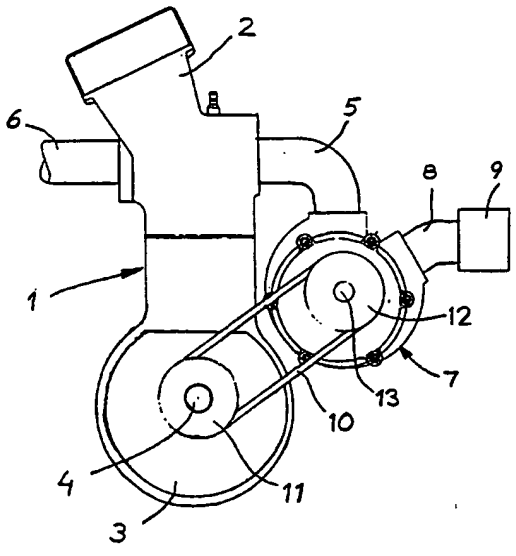

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A Method and a Device for Supplying Air to an Internal Combustion Engine.

The invention relates to a process for charging air into an internal combustion engine in accordance with the preamble to Claim 1 and an air-charging device for carrying out said process in accordance with the preamble to Claim 2.

In order for an internal combustion engine to function optimally, i.e. with the highest possible efficiency, air must be supplied to the engine in an amount which is adapted to the amount of fuel which is to be combusted so that the engine will produce the power required at that moment. The amount of air supplied and the amount of fuel supplied, of course, must thus be continually regulated and adjusted to the actual load conditions of the engine. In practically all known engines, air flow to the engine intake system is achieved either solely through the suction created by the engine or by this suction supplemented by the effect of a compressor. The amount of air supplied to the engine is regulated by a throttle. It is, however, difficult to achieve in this manner precise regulation of the amount of air supplied to the engine to obtain the best possible efficiency.

The purpose of the present invention is to provide a process and an air-charging device, which makes possible exact regulation of the amount of air supplied to the engine in accordance with the actual air requirements of the engine, so that optimum engine efficiency can be obtained. This is achieved by means of a process of the type described by way of introduction, which is characterized and specified in the characterizing clause of Claim 1, and by means of an air-charging device of the type described by way of introduction, which is charact-

erized by the features disclosed in the characterizing clause of Claim 2.

The invention will be described in more detail below with reference to the accompanying drawings, which, in part somewhat schematically, show various embodiments of the device according to the invention.

Fig. 1 is a schematic end view of an internal combustion engine which is provided with a device according to the invention.
Fig. 2 shows a longitudinal section through a device according to a first embodiment of the invention.
Fig. 3 is a partially cut-away end view of the device according to Fig. 2 with certain components removed.
Fig. 4 shows a cross-section through a device according to Fig. 2.
Fig. 5 shows a longitudinal section through a device according to a second embodiment of the invention.
Fig. 6 shows a cross-section through a device according to Fig. 5.
Fig. 7 shows a schematic cross-section through portions of the device according to Fig. 5.
Fig. 8 shows a cross-section corresponding to Fig. 7 with the components in other positions.

Fig. 1 shows quite schematically an internal combustion engine 1 with a cylinder head 2 and an engine block 3. In the engine block 3, there is mounted a crankshaft 4. The engine 1 has one or more cylinders, but the number of cylinders is of minor importance to the present invention, and no specific number of cylinders is therefore specified here. The engine 1 is provided with an intake system 5 and an exhaust system 6 which are only partially shown here.

An air charging device 7 according to the invention is coupled to the intake system 5 of the engine 1 for charging air into the internal combustion engine 1. The charging device 7 takes in air through an inlet duct 8 which is provided with an air filter 9. The air which the air charging device 7 takes in is usually ambient air but it is also conceivable to provide the charging device 7 with air of another temperature and/or pressure. In this context, it should also be noted that the charging device 7 does not need to be provided with air of normal make-up; rather, it is also conceivable to provide the charging device 7 with a gas or gas mixture of another composition, possibly even mixed with fuel. For the sake of simplicity, however, this description will use the term "air" and this term is meant also to encompass the above described variations.

The air charging device 7 is driven by means of a drive means 10, which in accordance with Fig. 1 is driven by means of a pulley 11 mounted on the crankshaft 4. The drive means 10 drives in turn a pulley 12 which is fixed on a shaft 13 in the charging device 7. The drive means 10 can be any known type of drive means, for example a chain, a toothed belt or the like. Alternatively, the power transmission means 10-12 can be a gear transmission or some other type of power transmission.

Figs. 2-4 show the charging device 7 in more detail. Fig. 2 reveals that the shaft 13 is mounted in bearings 14 in a housing 15. The housing 15 has ends 16 and an intermediate portion 17 with which the ends 16 are joined by means of screws 18.

In each of the ends 16, there is an end plate 19 facing the intermediate portion 17, by means of which plate a bearing 20 is mounted for rotation about an axis 21 lying spaced from the rotational axis 22 of the shaft 13 (see

Fig. 3). The axis 21 is thus concentrically located in the housing 15, the interior of which is circular cylindrical. Axially, the end plates 19 rest against thrust bearings 23 which are arranged between the end plates 19 and the inside of the ends 16.

The shaft 13 supports a circular cylindrical rotor 24, which is provided with a plurality of radial slots 25 for radial vanes 26, which are displaceable radially in the slots 25. The radially outer end of each of the vanes 26 is provided with a sealing means 27 which is designed to provide a seal between the vane 26 and the housing 15.

Inside the housing 15, there is a fixed cylinder wall 28, against the inside of which a sealing means 27 seals. Over a portion of its surface, the cylinder wall 28 is perforated by holes 29. Outside the holes 29, the housing 15 is provided with an inlet duct 30, to which the inlet pipe 8 is connected. The holes 29 are arranged in a pattern which is shown with dashed lines in Fig. 2 and is intended to constitute an inlet to the interior of the housing 15. The cylinder wall 28 is also provided with a delivery opening 31 which opens into a delivery duct 32 in the housing 15. The delivery duct 32 is in turn connected to the air intake system 5 of the engine 1.

Outside the cylinder wall 28, there is an exterior semi-cylindrical shell 33 which is guided for movement essentially in contact with the outside of the cylinder wall 28. The movement of the shell 33 is achieved with the aid of a pinion 34 in engagement with teeth on the outside of the shell 33. As it moves, the shell 33 will to a greater or lesser extent expose the holes 29 to allow air from the inlet duct 32 to enter the interior of the housing 15.

In order to reduce the friction between the vanes 26 and the cylinder wall 28 as the rotor 24 rotates in the housing 15, each of the vanes 26 is provided with pins 35 which extend into holder means 36 arranged in cavities 37 in the end plates 19. This means that the end plates 19 will be pulled along as the rotor 24 rotates, thus largely avoiding friction and wear between the ends of the vanes 26 and the cooperating surfaces of the end plates 19. At the same time, the pins 35 keep the vanes 26 somewhat spaced from the cylinder wall 28 so that the contact and seal between the vanes 26 and the cylinder wall 28 is only maintained with the aid of the relatively light sealing means 27. This appreciably reduces the friction and wear due to contact between the vanes 26 and the cylinder wall 28.

When the shaft 13 is driven by means of the drive means 10-12, the rotor 24 will rotate and the vanes 26 will sweep with their sealing means 27 along the inside surface of the cylinder wall 28. The vanes 26 will thus seal, on one hand, against the inside of the cylinder wall 28 and, on the other hand, against the end plates 19 and delimit separate air chambers 38, in each of which there is a specific amount of air which is transported from the inlet duct 30 to the delivery duct 32. During this transport, the air enclosed in an air chamber 38 is subjected to changes in its state which are different depending on the position of the shell 33.

Fig. 3 shows the shell in a position, where it covers the major portion of the holes 29 forming the inlet opening. This means that air from the inlet duct 30 will flow into an air chamber 38, the volume of which is relatively small since it is closed off when the rear vane 26, as seen in the rotational direction of the rotor 24, passes the edge of the shell 33. The rotor 24 rotates clockwise, as seen in Figs. 3 and 4. The continued rotation of the

rotor 24 will cause the air enclosed in the air chamber 33 to first perform work by expanding, with an accompanying reduction in temperature, and thereafter be subjected to a certain amount of re-compression to a suitable volume before the air is delivered through the delivery opening 31 to the delivery duct 32.

In Fig. 4, the shell 33 has been displaced clockwise from the position shown in Fig. 3 with the aid of the pinion 3, so that all the holes 29 are exposed and opened to the inlet duct 30. This means that the air chamber 38 is not delimited until the rear vane 26 as seen in the direction of rotation has passed all of the holes 29. Thus, the volume of the air chamber 38 is so large that no expansion of the amount of air is experienced; rather, there is only a compression up to when the air chamber 38 is opened towards the delivery opening 31 and the delivery duct 32.

It is evident from the above that by setting the position of the shell 33, it is possible to select the size of the amount of air which is enclosed in each air chamber 38 and which is transported as a delimited amount of air to the delivery opening 31 and the delivery duct 32. Depending on the position of the shell 33, the delimited amount of air in each air chamber 38 is subjected to a change in its state, which adapts the pressure and temperature of the air to the air requirements of the engine 1. By virtue of the fact that the charging device 7 is driven by the engine crankshaft 4 by means of the drive arrangement 10-12, and by virtue of the fact that this drive arrangement 10-12 provides a specific transmission ratio between the rotational speed of the crankshaft 4 and the rotational speed of the shaft 13 of the air charging device 7, the air charging device 7 will deliver, for each operating cycle of each of the cylinders of the engine 1, a specific amount of air to the engine intake

system 5. In this manner, it is possible, by setting the position of the shell 33 to regulate the air flow to the engine intake system 5 in such a manner that the air flow, as regards its volume and pressure, is exactly adapted to the actual air requirements of the engine 1.

Figs. 5-8 show an air charging device 39 according to another embodiment of the invention. The air charging device 39 shown in Figs. 5-8 has many similarities to the charging device 7 according to Figs. 2-4, and corresponding components have been provided with the same reference numerals with the addition of a prime symbol.

The air charging device 39 is driven in a similar manner to the charging device 7 by the engine crankshaft 4 by means of a drive arrangement 10-12. The charging device 39 is also coupled, in a manner similar to the air charging device 7, between an inlet duct 8 and the intake system 5 of the engine 1.

The air charging device 39 comprises a housing 15' which is composed of two end pieces 16' and an intermediate portion 17', the shaft 13' of the charging device 39 being mounted in bearings 14' in the end pieces 16'. In the end pieces 16', there are end plates 19' mounted in bearings 20' for rotation about an axis 21', which is concentrically placed in the housing 15'.

The shaft 13' supports a rotor 24', which rotates about the rotational axis 22' of the shaft 13'. As can be seen in Figs. 5-8, the rotational axis 22' is spaced from the axis 21' of the housing 15'.

The rotor 24' is provided with a number of radial slots 25', in which a number of vanes 26' are arranged. The radially outer ends of the vanes 26' are provided with sealing means 27', which are in contact with the interior

surface of a cylindrical drum 40. Each of the vanes 26' is also provided with pins 35', by means of which each wing 26' is suspended in the end plates 19' to avoid contact between the vanes 26' and the inside of the drum 40. This contact is provided instead by means of the sealing means 27', as can be seen in Figs. 6-8.

The cylindrical drum 40 is joined to the radially outer portions of the end plates 19' and rotates together therewith when the rotor 24' and the vanes 26' rotates. The vanes 26' and the sealing means 27' thus move very little relative to the end plates 19' and the drum 40. This movement is only limited reciprocal movement occurring as the vanes 26' move radially in the slots 25' in the rotor 24' as a result of the excentric mounting of the rotor 24' in the housing 15'.

The end plates 19' are provided radially inside the drum 40 with a large number of holes 41, which are arranged closely adjacent to each other around the entire periphery. The holes 41 establish communication axially between an inlet duct 30' and a delivery duct 32' and the interior of the housing 15', i.e. the air chambers 33' between the vanes 26'.

Axially outside the end plate 19' on the inlet side, i.e. between the portion of the end plate 19' provided with holes 41 and the intake duct 30', there is a cover plate 42, the function of which corresponds to the function of the shell 33 in the embodiment according to Figs. 1-4. The cover plate 42 is disposed to be moved by means of a pinion 34' and is provided with an elongated arcuate inlet opening 43. The cover plate 42 is mounted for rotation about an excentric disc 44 which is securely fixed in the end piece 16'. The placement of the cover plate 42 is such that between these components and the end plate 19' there is a thin air gap.

Turning the cover plate 42 by means of the pinion 34' will allow a greater or lesser portion of the inlet opening 43 to provide communication between the inlet duct 30' and the interior of the housing 15', i.e. the air chambers 38' between the vanes 26'. In this manner, it is possible in a manner similar to the embodiment according to Figs. 1-4, to delimit a greater or lesser amount of air in the air chambers 38' between two adjacent vanes 26'.

Axially outside of the end plate 19' on the delivery side, i.e. between the portion of the end plate 19' provided with the holes 41 and the delivery duct 32', there is a cover plate 45, which is made in a manner corresponding to the cover plate 42 and which is provided with a delivery opening 46, which provides communication between the air chambers 38' and the delivery duct 32'. The cover plate 45 is mounted for rotation about an excentric disc 47 permanently mounted in the end piece 16' in a manner corresponding to the cover plate 42 described above. The cover plate 45 is arranged to be rotated by a pinion (not shown) to make it possible to adjust the communication between the air chambers 38' and the delivery duct 32'.

The function of the air charging device 39 according to Figs. 5-8 is essentially the same as that of the charging device 7 according to Figs. 1-4. By regulating the position of the cover plate 42, it is thus possible to change the size and position of the communication between the inlet duct 30' and the air chambers 38' between adjacent vanes 26'. In this manner, it is possible to perform with the air charging device 39 the same function as was described above with reference to the air charging device 7 according to Figs. 1-4.

CLAIMS

1. Process for charging air into an internal combustion engine (1) with one or more cylinders and an intake system (5) for supplying air to the cylinder or cylinders by means of an engine driven air charging device (7, 39), comprising regulator means (33, 42) for regulating the flow of air delivered to the engine, depending on the actual air requirements of the engine, c h a r a c t - e r i z e d in that for each operating cycle of each of the cylinders of the engine (1), there is delimited a specific amount of air, regulated depending on the actual air requirements of the engine, which is fed through the air charging device (7, 39), and during its passage through the air charging device is subjected to a change in its state, so that when it is delivered into the intake system (5) it has a state which essentially corresponds to the state of the previously delivered air in the intake system (5), and that the air flow to the engine (1) is regulated by changing the volume of each amount of air at the delimitation of the same upon entry into the air charging device (7, 39).

2. Air charging device (7, 39) for carrying out the process according to Claim 1 for delivering air to an internal combustion engine (1) with one or more cylinders and an intake system (5) for supplying air to the cylinder or cylinders, said air charging device (7, 39) comprising regulator means (33, 42) for regulating the flow of air to the engine (1) depending on the actual air requirements of the engine, c h a r a c t e r i z e d in that the air charging device (7, 39) is provided with at least one air chamber (38, 38') for delivering a specific, delimited amount of air from an intake duct (30, 30') to a delivery duct (32, 32'), each air chamber (38, 38') being disposed to be moved from communication

with the intake duct (30, 30') to communication with the delivery duct (32, 32') by meas of a drive arrangement (10-12) which is coupled to the engine (1) to be driven thereby in a predetermined relationship to the rotation of the engine crankshaft (4), regulator means (33, 42) being arranged to regulate the volume of each air chamber (38, 38') when it communicates with the intake duct (30, 30').

3. Air charging device according to Claim 2, c h a r - a c t e r i z e d in that it is of a vane compressor type with a cylindrical rotor (24, 24') excentrically placed in a cylindrical housing (15, 15') and with essentially radially disposed vanes (26, 26'), which delimit between them air chambers (38, 38'), and that the communication of each air chamber with the intake duct (30, 30') is arranged to be terminated by means of regulator means (33, 42) at a predetermined adjustable position.

4. Air charging device according to Claim 3, c h a r - a c t e r i z e d in that the inlet duct (39) is arranged radially outside the vanes (26) in the housing (15), and that the communication between the inlet duct (30) and the interior of the housing (15) consists of a number of holes (29) in the cylindrical wall (28), against the inside of which the vanes (26) seal, said regulator means comprising a shell (33) which is arranged radially outside the cylindrical wall (28) and is displaceable peripherally along said wall to cover a greater or lesser portion of the portion of the cylindrical wall (28) provided with the walls (29).

5. Air charging device according to Claim 4, c h a r - a c t e r i z e d in that the delivery duct (32) is arranged radially outside the vanes (26) in the housing (15) and that the communication between the interior of

the housing (15) and the delivery duct (32) consists of a delivery opening (31) in the cylinder wall (28).

6. Air charging device according to Claim 4 or 5, c h a r a c t e r i z e d in that the shell (33) is arranged to be adjusted by means of a drive means (34) which is arranged in the housing (15).

7. Air charging device according to Claim 3, c h a r - a c t e r i z e d in that the inlet duct (30') is arranged axially to one side of the vanes (26') and the housing (15') and that the communication between the inlet duct (30') and the interior of the housing (15') consists of a number of holes (41) in an end plate (19'), which rotates together with the rotor (24') and a drum (40), against the inside of which the vanes (26) seal, said regulator means comprising a cover plate (42), which is arranged axially outside the end plate (19') and is peripherally rotatable and is provided with an inlet opening (43), the position of which is changed as the cover plate (42) is rotated.

8. Air charging device according to Claim 7, c h a r - a c t e r i z e d in that the delivery duct (32') is arranged axially outside the vanes (26') in the housing (15') on the side opposite the inlet duct (30'), and that a cover plate (45) with a delivery opening (46) is arranged axially outside the end plate (19') with a number of holes (41) for communication between the interior of the housing (15') and the delivery duct (32'), said cover plate (45) being rotatable peripherally to change the position of the delivery opening (32').

9. Air charging device according to Claim 8, c h a r - a c t e r i z e d in that drive means (34') are arranged in the housing (15') to set the cover plates (42, 45).

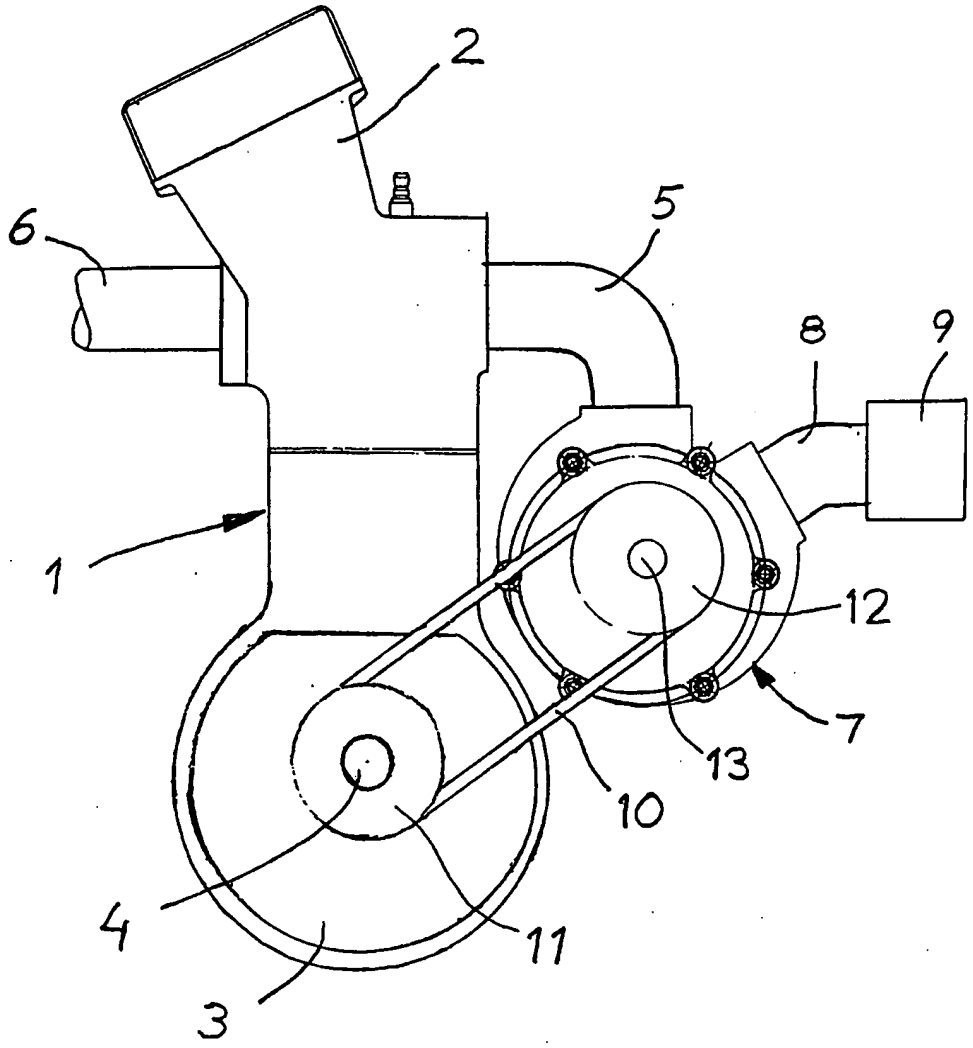


Fig. 1

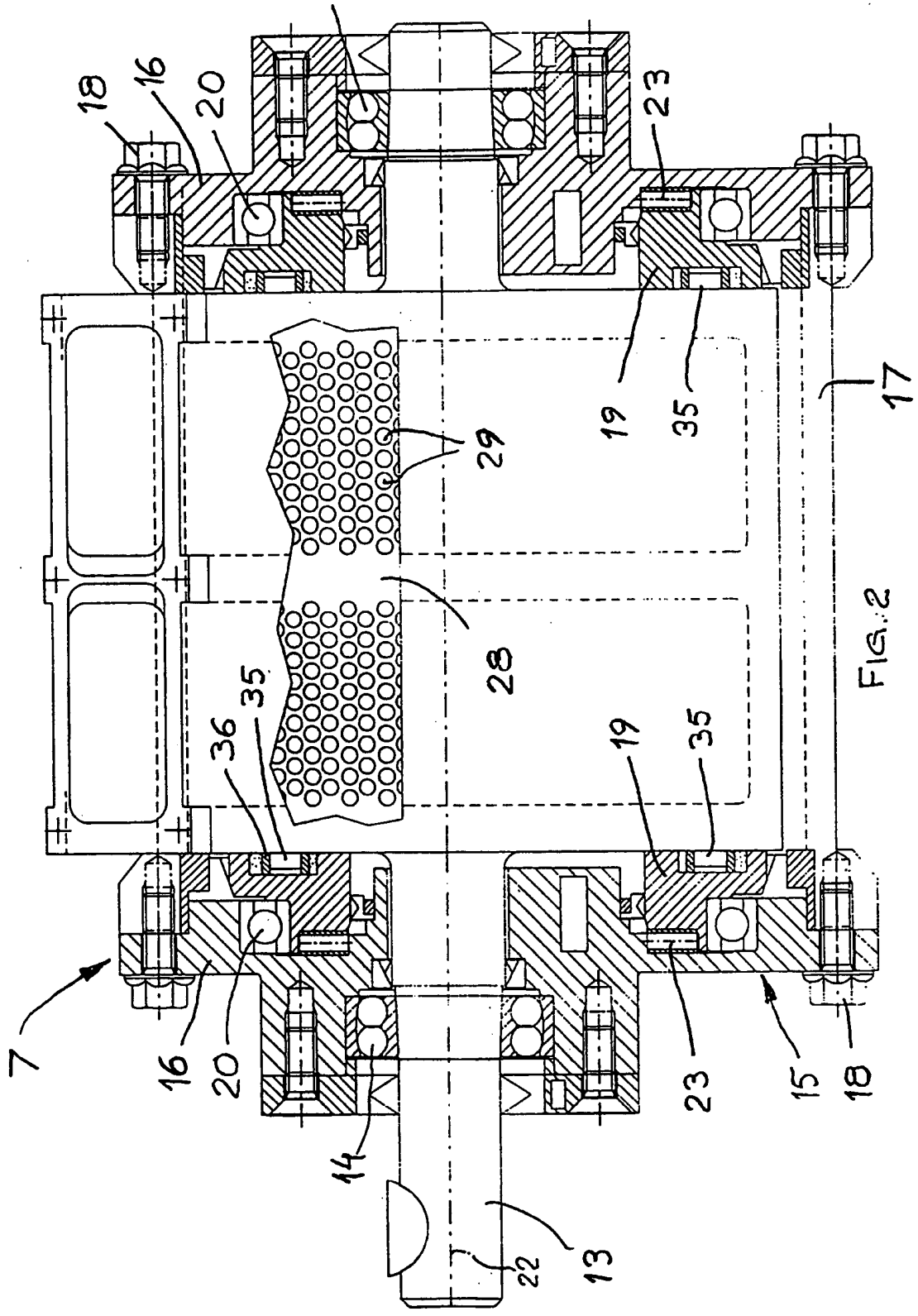


Fig. 2

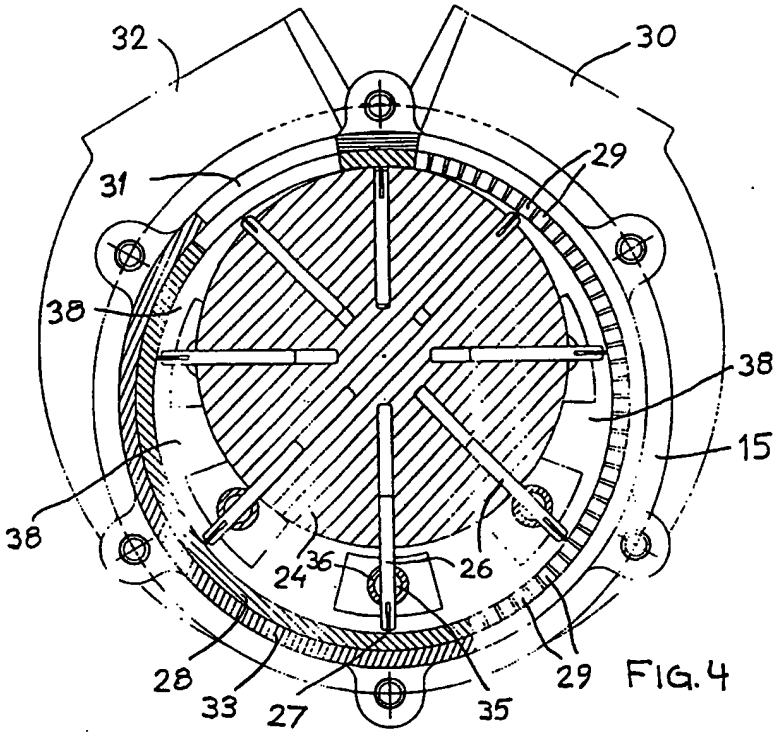


Fig. 4

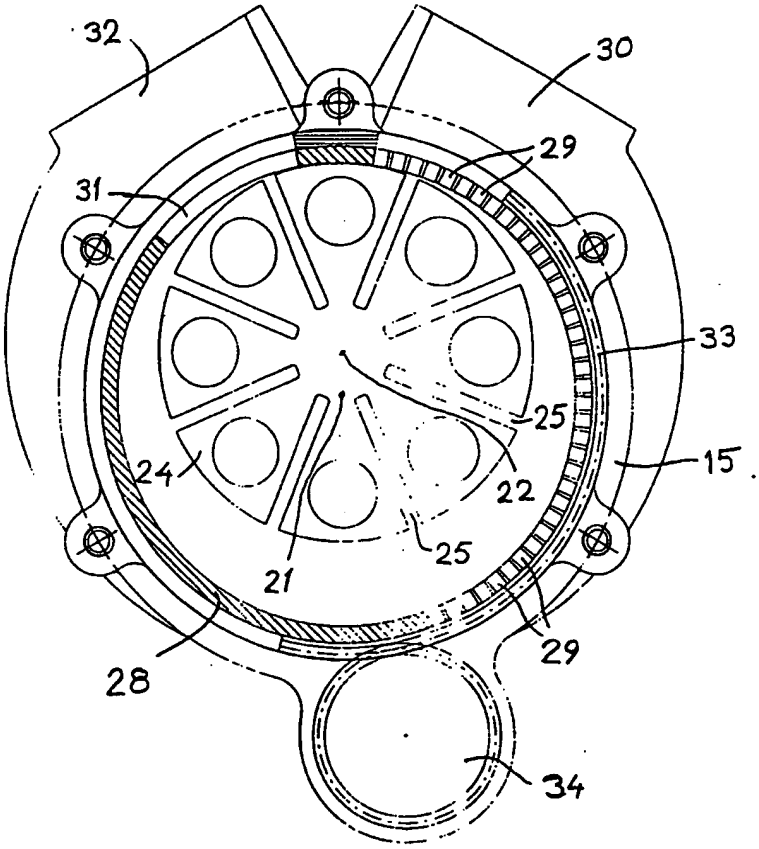


Fig. 3

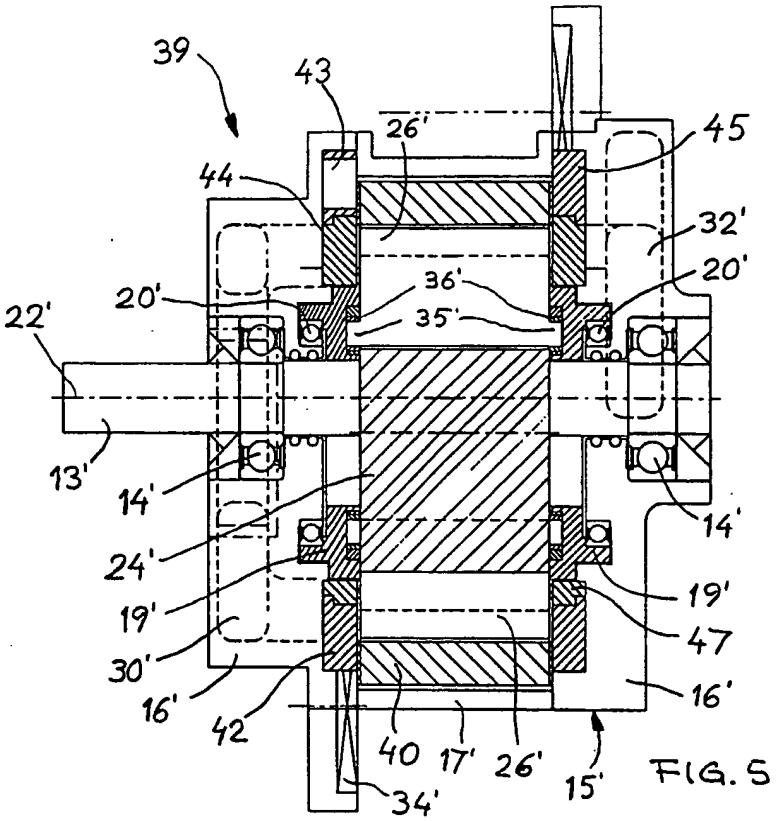
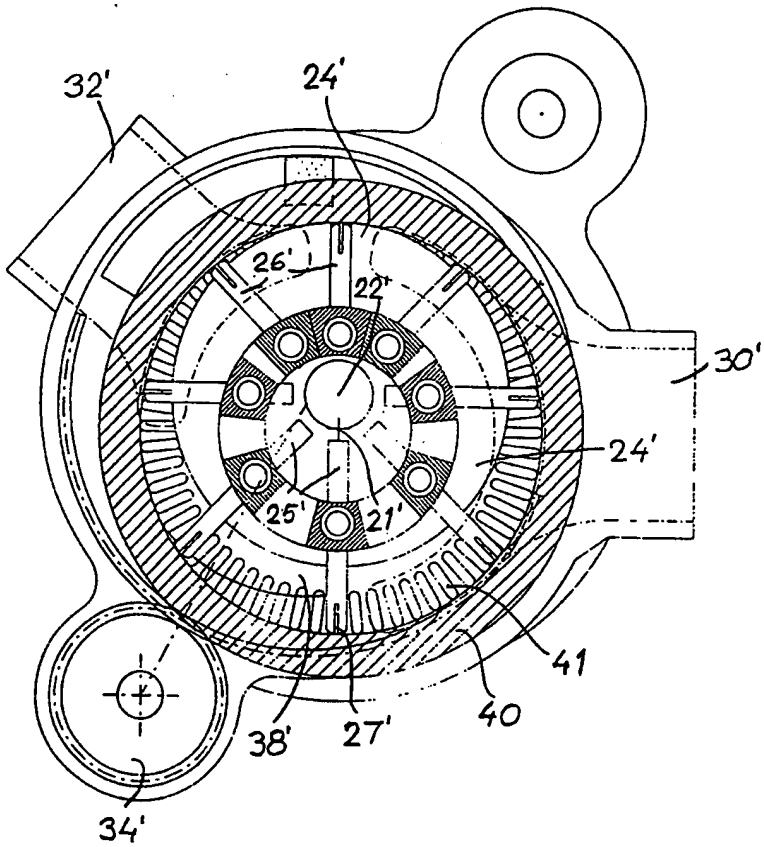


FIG. 5



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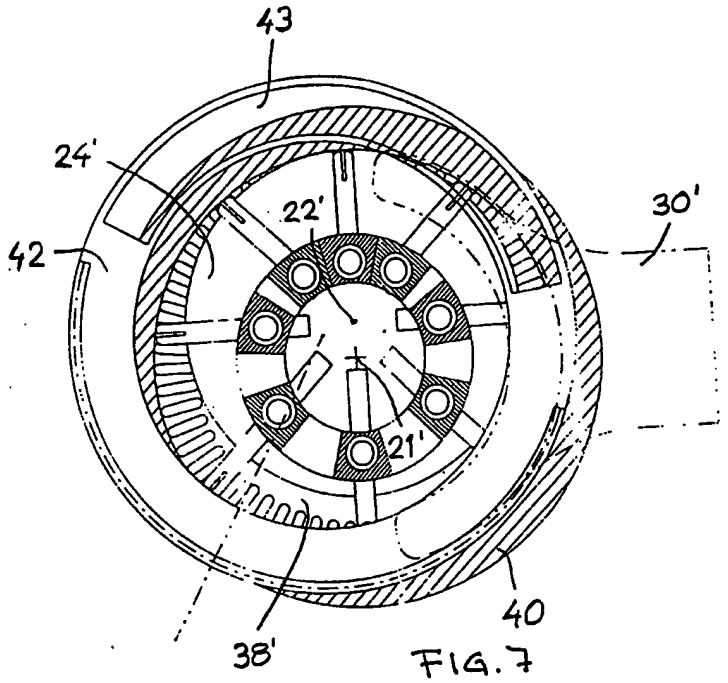

Fig. 7

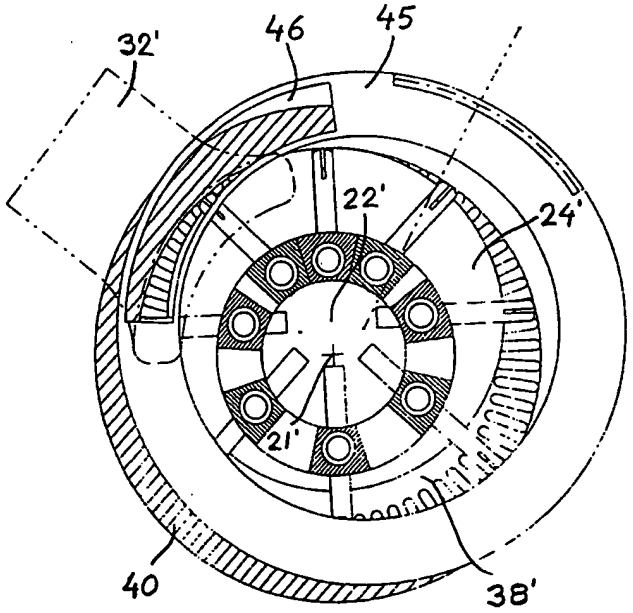

Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 93/00599

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: F02B 33/36
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE, C, 413309 (ARNOLD ZOLLER), 7 May 1925 (07.05.25) --	1-9
Y	DE, C, 424047 (ARNOLD ZOLLER), 15 January 1926 (15.01.26), page 2, line 55 - line 60; page 3, line 29 - line 93 --	1-9

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Herman Phalén Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-C- 413309	07/05/25	NONE	
DE-C- 424047	15/01/26	NONE	

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TITLE: A METHOD AND A DEVICE FOR SUPPLYING AIR TO AN INTERNAL COMBUSTION ENGINE

PUBN-DATE: January 6, 1994

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ABSTRACT:

The invention relates to a process for charging air into the intake system (5) of an internal combustion engine (1) by means of an engine-driven air charging device (7) with regulator means for regulating the flow of air to the engine depending on the current air requirements of the engine. The process is characterized in that for each operating cycle, a specific amount of air is delimited, which is fed through the air charging device (7) and is subjected to a change in its state, so that upon delivery to the intake system (5) it has essentially the same state as the air in the intake system (5). The air flow through the engine (1) is regulated by changing the volume of each amount of air when it is delimited. The invention also relates to an air charging device

(7) for carrying out the process, said air charging device (7) being provided with at least one air chamber, which is moved for feeding a specific, delimited amount of air from an inlet duct to a delivery duct, from communication with the inlet duct to communication with the delivery duct, by means of a drive arrangement (10-12), which is driven by the engine (1) in a predetermined relationship to the rotation of the engine crankshaft (4). The regulator means are arranged to regulate the volume of each air chamber when it communicates with the inlet duct.